


PCT/PTO 25

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference 800186WO	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/FI 03/00575	International filing date ( <i>day/month/year</i> ) 18.07.2003	Priority date ( <i>day/month/year</i> ) 26.07.2002
International Patent Classification (IPC) or both national classification and IPC H01L31/01		
Applicant DETECTION TECHNOLOGY OY et al.		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 4 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the opinion</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input type="checkbox"/> Certain defects in the international application</li> <li>VIII <input type="checkbox"/> Certain observations on the international application</li> </ul>		
Date of submission of the demand  12.02.2004	Date of completion of this report  04.10.2004	
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Kuszteľan, L  Telephone No. +49 89 2399-2479	



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/FI 03/00575

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-13 as originally filed

**Claims, Numbers**

1-39 received on 27.09.2004 with letter of 27.09.2004

**Drawings, Sheets**

1-8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
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International application No. **PCT/FI 03/00575**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-35
	No: Claims	
Inventive step (IS)	Yes: Claims	1-35
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-35
	No: Claims	

2. Citations and explanations

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/FI 03/00575

1. Reference is made to the following documents:
  - D1: PATENT ABSTRACTS OF JAPAN vol. 1999, no. 14, 22 December 1999 (1999-12-22) & JP 11 261086 A (SHARP CORP), 24 September 1999
  - D2: WO 98 54554 A (HILSUM CYRIL ;SECR DEFENCE (GB); WATTON REX (GB)) 3 December 1998 (1998-12-03)
  - D3: US-A-5 599 744 (MCCAUSLAND CONNIE S ET AL) 4 February 1997
  - D4: US-B1-6 173 031 (KOTIAN FRANCOIS ET AL) 9 January 2001
  - D5: US-B1-6 396 898 (SAITO YASUO ET AL) 28 May 2002 (2002-05-28)
2. The Application does not meet the Requirements of Art.6 PCT because claims 1 & 20 are not clear.
  - 2.1 The claims 1 & 20 feature "cathode on a second surface of the substrate" concerns a means of operating the device which thus does correspond to an unambiguously defined device feature. Moreover, support for the generalised cathode feature, not comprising an active area on the second surface of the substrate, cf. claim 13 as originally filed, essential to the invention since it provides a solution to the problem of the limitation on the size of photodetector arrays, cf. description pg.2, could not be located Art.6 as well as Art.34(2)(b) PCT.
  - 2.2 The claims 1 & 20 feature "array of photodetectors for computed tomography" is unclear since it is not apparent if protection is sought only for the photodetector array as such (suitable for uses such as computed tomography) or if protection is sought for an array of photodiodes of a computed tomography system. Moreover, the available support for the first option could not be located, cf. claims 1,18-20 as originally filed, Art.6 as well as Art.34(2)(b) PCT.
3. Interpreting the claims with the aid of the description, cf. objections of Section 2 above, attention is drawn to the following:
  - 3.1 D1, cf. Abs. & Fig.3 concerns a via connected photodiode array with active area connections on the substrate lower surface, used in a battery. There is no disclosure for an array of photodiodes of a computed tomography system
  - 3.2 D2, cf. Abs.fig. concerns a photodetector array with one electrode via connected through an underlying substrate. There is no disclosure of a substrate with active regions on upper & lower surfaces.

- 3.3 D3, cf. Figs.1-6 & text discloses via substrates for photodetectors. There is no disclosure of a substrate with active regions on upper & lower surfaces.
- 3.4 D4, cf. fig.4 & text & D5, cf. fig.20 disclose photodiode arrays in CT systems. There are no details of the photodetector array devices.

The claimed subject-matter is therefore new. D1 is closest prior art however does not point to an array of such photodiodes of a computed tomography system. Consequently an inventive nature of claim 1 & corresponding method claim 20 is appreciated.

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### CLAIMS

1. A substrate including an array of photo-detectors, each photodetector of the array having an active area on a first surface of the substrate and a cathode on a second surface of the substrate, wherein each photodetector of the array is provided with a conductive via from the first surface of the substrate to the second surface of the substrate for connecting the active area to the second surface of the substrate.
2. A substrate according to claim 1 wherein the conductive vias are electrically isolated from the substrate.
3. A substrate according to claim 1 or claim 2 wherein the conductive vias comprise polysilicon.
4. A substrate according to claim 3 wherein the polysilicon is formed on the inner walls of the vias.
5. A substrate according to claim 4 wherein there is provided a further conductive element from the first side of the substrate to the second within at least one of the conductive vias.
6. A substrate according to claim 4 wherein there is provided a filling material within at least one of the conductive vias.
7. A substrate according to any one of claims 1 to 6 wherein there is provided a further conductive element connected between the active area of the at least one of the photo-detectors and the respective conductive via.
8. A substrate according to any one of claims 1 to 7 wherein there is provided a further conductive element on the second side of the substrate connected to at least one of the conductive vias.
9. A substrate according to claim 8 wherein the further conductive element on the second side of the substrate is for making an off-chip connection to the conductive via.
10. A substrate according to any one of claims 1 to 9 wherein the photo-detectors are photodiodes

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AMENDED SHEET

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11. A substrate according to claim 10 wherein the active areas on the first surface of the substrate anodes.
12. A substrate according to any one of claims 1 to 11 wherein the cathodes of the photo-detectors are formed as a layer on the second surface.
- 5 13. A substrate according to any one of claims 1 to 12 wherein the photodetectors are photodiodes of a medical imaging system.
14. A substrate according to claim 13 wherein the medical imaging system is a computed tomography system.
15. A substrate according to any one of claims 1 to 14 wherein the array of  
10 photo-detectorsextends in two directions.
16. A substrate according to any one of claims 1 to 15 wherein the array of photo-detectors is arranged into a plurality of sub-arrays of photo-detectors.
17. A substrate according to any one of claims 1 to 16, wherein the vias are adjacent to the respective photo-detectors.
- 15 18. An imaging system comprising: a radiation detector including a photo-detector array formed in at least one substrate according to any one of claims 1 to 17, a radiation source facing the radiation detector, and means for controlling the radiation detector and the radiation source.
19. An imaging system according to claim 18 wherein the radiation source is  
20 an X-ray tube equipped with a high-voltage generator.
20. An imaging system according to claim 18 or claim 19 wherein the radiation detector and the radiation source are radially mounted in a cylindrical scanning structure.
21. An imaging system according to any one of claims 18 to 20 wherein the  
25 means for controlling comprises a computer system.
22. A method of manufacturing an array of photo-detectors comprising: providing for each of the photodetectors of the array an active area on a first surface of a substrate; providing for each of the photo-detectors a cathode on a second surface of the substrate; forming for each of the photo-detectors a  
30 conductive via through the substrate from the first surface of the substrate to a

second surface of the substrate, the conductive via being adjacent to the respective anode; and connecting the active areas to the conductive vias such that the active areas are connected to the second surface of the substrate.

23. A method according to claim 22 further comprising the step of electrically  
5 isolating the conductive vias from the substrate.

24. A method according to claim 22 or claim 23 wherein the conductive vias comprise polysilicon.

25. A method according to claim 24 further comprising the step of forming polysilicon on the inner walls of the vias.

10 26. A method according to claim 25 further comprising the step of providing at least one further conductive element from the first surface of the substrate to the second surface within at least one of the conductive vias.

27. A method according to claim 25 further comprising the step of providing a filling material within at least one of the conductive vias.

15 28. A method according to any one of claims 22 to 27 further comprising the step of providing at least one further conductive element connected between at least one of the active areas and at least one of the conductive vias.

29. A method according to any one of claims 22 to 28 further comprising the step of providing at least one further conductive element on the second surface of  
20 the substrate connected to at least one of the conductive vias.

30. A method according to claim 28 wherein the further conductive element is a contact pad.

31. A method according to claim 29 or claim 30 wherein the further conductive element on the second surface of the substrate is provided for making an off-chip  
25 connection to the conductive via.

32. A method according to any one of claims 22 to 31 wherein the photo-detectors are photodiodes.

33. A method according to claim 32 wherein the active areas on the first surface of the substrate are anodes.



34. A method according to any one of claims 22 to 33 wherein the cathodes of the photo-detectors are formed as a layer on the second surface of the substrate.
35. A method according to any one of claims 22 to 34 wherein the photo-detectors are photodiodes of a medical imaging system.
- 5 36. A method according to claim 35 wherein the medical imaging system is a computed tomography system.
37. A method according to any one of claims 22 to 36 wherein the array of photo-detectors is provided as a plurality of sub-arrays of photo-detectors.
38. A method according to any one of claims 22 to 37 wherein the vias are  
10 adjacent to the respective photo-detectors.
39. A radiation detector including photo-detectors formed in at least one substrate according to any one of claims 1 to 17.